PCT WORLD INTELLECTUAL PROPERTY ORGANIZATION
International Bureau

INTERNATIONAL APPLICATION PUBLISHED UNDER THE PATENT COOPERATION TREATY (PCT)

(51) International Patent Classification 6 : F41J 5/02	A1	(11) International Publication Number: WO 96/15420
		(43) International Publication Date: 23 May 1996 (23.05.96)

(21) International Application Number: PCT/IE95/00058

(22) International Filing Date: 10 November 1995 (10.11.95)

(30) Priority Data:

940880	11 November 1994 (11.11.94)	IE
950567	24 July 1995 (24.07.95)	IE

(71) Applicant *(for all designated States except US)*: SIX GRID LIMITED [IE/IE]; 8 Upper Fitzwilliam Street, Dublin 2 (IE).

(72) Inventors; and

(75) Inventors/Applicants *(for US only)*: ASHBURNER, Keki, Adi [GB/IE]; Unit 30, IDA Business Centre, Whitestown Road, Tallaght, Dublin 24 (IE). CAFOLLA, Ivano [IE/IE]; Leisurecorp House, 8 Upper Fitzwilliam Street, Dublin 2 (IE). NELSON, Daniel, R. [IE/IE]; Industrial Park, St Patrick's College, Maynooth, County Kildare (IE). MALOCO, John [IE/IE]; 159 Rockfield Walk, Maynooth, County Kildare (IE). McHUGH, Adrian [IE/IE]; 3 Stonepark Abbey, Grange Road, Rathfarnham, Dublin 14 (IE). MEATH, Fergal [IE/IE]; Avondale, Botanic Villas, Glasnevin, Dublin 9 (IE). NAUGHTON, Thomas [IE/IE]; 59 Rose Lawn Road, Dublin 12 (IE). GLEESON, Daniel [GB/IE]; 42 Parklands Square, Maynooth, County Kildare (IE). RUSZNYAK, Peter [HU/HU]; 1013 Attila 67, Budapest (HU).

(74) Agents: O'CONNOR, Donal, H. et al.; Cruickshank & Co., 1 Holles Street, Dublin 2 (IE).

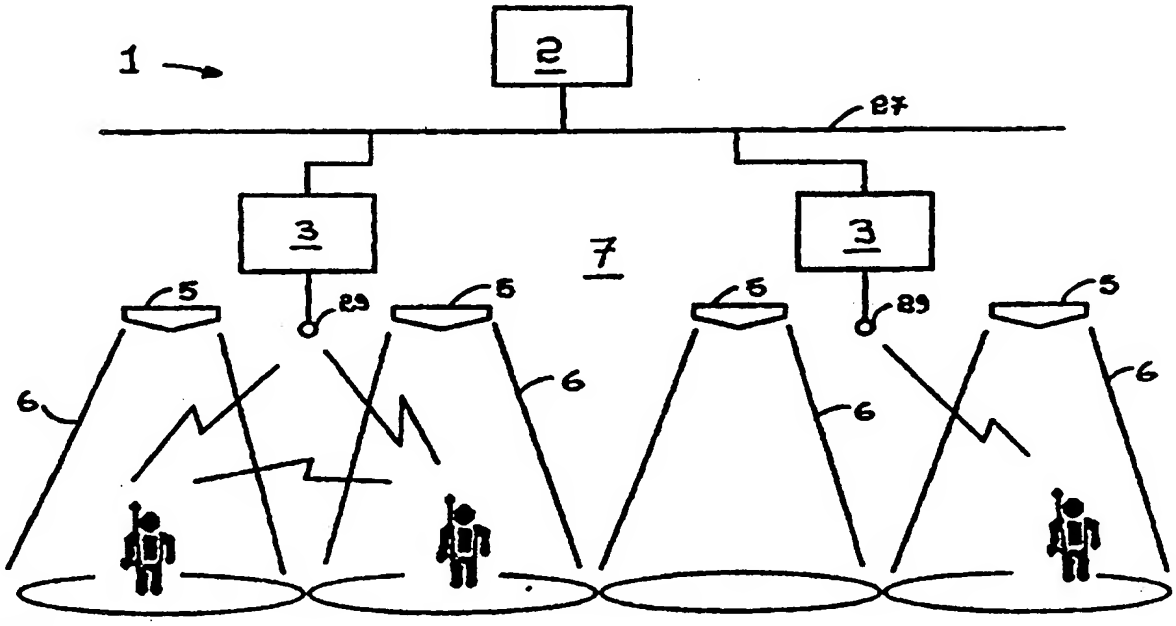
(81) Designated States: AM, AT, AU, BB, BG, BR, BY, CA, CH, CN, CZ, DE, DE (Utility model), DK, DK (Utility model), EE, ES, FI, GB, GE, HU, IS, JP, KE, KG, KP, KR, KZ, LK, LR, LT, LU, LV, MD, MG, MN, MW, MX, NO, NZ, PL, PT, RO, RU, SD, SE, SG, SI, SK, TJ, TM, TT, UA, UG, US, UZ, VN, European patent (AT, BE, CH, DE, DK, ES, FR, GB, GR, IE, IT, LU, MC, NL, PT, SE), OAPI patent (BF, BJ, CF, CG, CI, CM, GA, GN, ML, MR, NE, SN, TD, TG), ARIPO patent (KE, LS, MW, SD, SZ, UG).

Published

With international search report.

Before the expiration of the time limit for amending the claims and to be republished in the event of the receipt of amendments.

(54) Title: COMMUNICATION IN AN ELECTRONIC SHOOTING GAME



(57) Abstract

The invention relates to an electronic shooting game apparatus providing real time communication between a central controller (2) and a number of mobile player units (4) in a game playing arena. Each of the mobile player units (4) having a unique communication time slot period.

FOR THE PURPOSES OF INFORMATION ONLY

Codes used to identify States party to the PCT on the front pages of pamphlets publishing international applications under the PCT.

AT	Austria	**GB**	United Kingdom	**MR**	Mauritania
AU	Australia	**GE**	Georgia	**MW**	Malawi
BB	Barbados	**GN**	Guinea	**NE**	Niger
BE	Belgium	**GR**	Greece	**NL**	Netherlands
BF	Burkina Faso	**HU**	Hungary	**NO**	Norway
BG	Bulgaria	**IE**	Ireland	**NZ**	New Zealand
BJ	Benin	**IT**	Italy	**PL**	Poland
BR	Brazil	**JP**	Japan	**PT**	Portugal
BY	Belarus	**KE**	Kenya	**RO**	Romania
CA	Canada	**KG**	Kyrgystan	**RU**	Russian Federation
CF	Central African Republic	**KP**	Democratic People's Republic of Korea	**SD**	Sudan
CG	Congo			**SE**	Sweden
CH	Switzerland	**KR**	Republic of Korea	**SI**	Slovenia
CI	Côte d'Ivoire	**KZ**	Kazakhstan	**SK**	Slovakia
CM	Cameroon	**LI**	Liechtenstein	**SN**	Senegal
CN	China	**LK**	Sri Lanka	**TD**	Chad
CS	Czechoslovakia	**LU**	Luxembourg	**TG**	Togo
CZ	Czech Republic	**LV**	Latvia	**TJ**	Tajikistan
DE	Germany	**MC**	Monaco	**TT**	Trinidad and Tobago
DK	Denmark	**MD**	Republic of Moldova	**UA**	Ukraine
ES	Spain	**MG**	Madagascar	**US**	United States of America
FI	Finland	**ML**	Mali	**UZ**	Uzbekistan
FR	France	**MN**	Mongolia	**VN**	Viet Nam
GA	Gabon				

"Communication in an electronic shooting game"

The invention relates to communication in a game of the electronic shooting type.

Such games provide for a number of players each fitted with a body pack playing the electronic shooting game in an arena. US Patent No. 4,695,058 describes the communication of player status information such as the number of hits received by the player body pack during the course of the game to a game controller using RF transmissions. This method allows information to be passed between the player units and the game controller to display information such as a player's score, however, the interaction is limited due to the speed of communication.

It is an object of the invention to provide an electronic shooting game apparatus with improved communication.

Statements of Invention

Accordingly there is provided an electronic shooting game apparatus comprising:

a controller for controlling the course of a game in an arena;

at least one mobile player unit; and

a game communication means comprising means for wireless communication between the controller and each mobile player unit in real time.

Advantageously this allows the player to send and receive status information from the game controller in real time obviating the need for the player to periodically pass a control point to update system information.

Preferably, the game communication means comprises a mobile player unit communication means for directing communication of each mobile player unit during a unique time slot associated with each mobile player unit.

This is a particularly effective way of achieving real time communication as it is relatively simple and avoids interference.

Preferably the controller comprises a control processor and at least one control device, and the game communication means comprises a player communication means in the control device, the control device being mounted in the arena for controlling communication between the central processor and each mobile unit during the unique communication time slot.

This allows the control devices to be strategically positioned throughout the game arena, as the mobile player unit have a unique communication period the risk or communication interference is eliminated without requiring multiple communication channels and without the delays associated with polling of individual mobile player units.

Preferably the controller comprises a central processor communicating with a plurality of physically separate control devices mounted in the arena, thereby allowing the control devices to be easily distributed throughout the arena to provide adequate transmission / reception coverage. Advantageously, the control devices may be easily moved at any time. This is particularly useful when it is desired to modify the layout of the arena to maintain player interest. Obstacles may also be used in the arena without hindering communication. These obstacles may be naturally occurring features of the arena such as walls or obstacles included to enhance reality and player enjoyment.

Preferably the player communication means has a transmitter with an associated transmission field in the arena, for transmitting game information from the

control device to each mobile player unit located within the transmission field. Thus, each mobile player unit will receive game information from the control device transmission field in which it is located.

Preferably each control device comprises a timing means for determining a unique control device transmit period for the player communication means associated with the control device. Thus, the control devices may transfer information in turn without the risk of transmission interference between adjacent control devices. This feature further allows a number of mobile player units to communicate without requiring additional channels necessitating increased bandwidth.

Ideally a plurality of control devices are provided, each control device having an associated transmission field for defining a transmission region within the arena and for transmitting game information from the control device to the mobile player units located within the transmission field of the control device. Thereby, ensuring that all mobile player units within the game arena will receive the game information in real time.

Preferably the transmitter is a radio frequency transmitter thus, the transmission is provided in a simple and efficient manner.

Preferably each player communication means has a player communication controller and a device identification means for controlling the player communication means. Advantageously, allowing each individual control device to be configured to operate in a predefined manner and further allows the control device to be easily re-configured even during the course of a game.

Ideally the player communication means has a receiver for receiving signals from the mobile player unit. Thus, the control device may receive game status information from the mobile player unit, this information may be either be acted on locally or communicated to the central processor. In this way the

shape or size of the game playing arena may be altered without adversely affecting game communications.

In one arrangement the transmitter and receiver are combined as a transceiver thereby reducing the number of components required.

Preferably the control device has a host communication means for communicating with the central processor. Thereby, allowing game status information to be communicated to the central processor. This allows a single centralised processor to be used to control the game throughout the entire arena, minimising the processing requirements of the control devices without adversely affecting game response times.

Preferably the host communication means has a host communication controller, a data buffer and a communication link for connection between the central processor and the data buffer. Thus, constant access to the central processor is obtained eliminating the possibility of delay in communications additionally the capabilities of the apparatus may be easily expanded to accommodate increasing numbers of players by increasing the processing power or number of central processors.

Preferably the host communication controller and the player communication controller are integrally formed as a device communication controller thereby reducing component requirements by combining functionality.

Ideally the device communication controller is a microcontroller with associated memory and timing means for controlling communication between the control device and the central processor and between the control device and the mobile player unit. Beneficially, using standard components thereby reducing cost.

Ideally each mobile player unit communication means has a processor with associated memory means for controlling the mobile player communication means. Advantageously,

this allows processing to be conducted locally within the player unit.

Preferably the mobile player unit communication means has a player unit transmitter for transmitting game information from the mobile player unit to the control device. Thus, information may transferred in real time between the mobile player unit and the controller.

Ideally each mobile player unit incorporates a timing means for determining a unique transmit period associated with the mobile player unit. Thus, each player unit may communicate game information within the arena without the risk of transmission interference.

Preferably the player unit communication means has a player unit receiving means and a player unit transmitter advantageously, allowing the player unit to receive and transmit game status information.

Ideally the player unit receiving means has a control receiver for receiving status data from the controller thereby, establishing a communications link with the central processor.

Preferably the control receiver includes means for receiving status data from another mobile player unit. Thus, team or opposing team status information may be shared further enhancing the players enjoyment of the game by allowing the players to develop tactics.

In one arrangement the control receiver and the player unit transmitter are formed as a mobile player unit transceiver. Thus, the number of components required is reduced thereby minimising the weight and cost of the unit.

In one arrangement the game communication means comprises means in the controller for assigning the unique communication time slot period for each mobile player unit and control device node by storing relationships between fixed or real node identifiers and

alias identifiers, the alias identifiers identifying the unique time slot period.

Preferably the controller comprises means for transmitting signals re-configuring the apparatus by re-assigning alias identifiers with real identifiers in real time.

Ideally the controller comprises means for re-configuring the apparatus by transmitting a reconfiguration signal comprising a reference followed by a series of real identifiers in successive time slots, and each node comprises means for identifying its real identifier and storing an indication of the position of said identifier in the reconfiguration signal to set its alias identifier as a configuration.

Preferably the controller comprises means for assigning alias identifiers to only a portion of the nodes of the apparatus at any particular time. Thus, if the number of players is less than the number of players expected for a given game the number of time slots may be reduced in real time to further optimise response times.

Preferably the controller comprises means for transmitting synchronisation signals which include a synchronisation frame for synchronisation of clocks in the nodes, followed by a series of time slots within which nodes can respond in the relevant appropriate time slot, each node determining its time slot according to its current alias identifier.

In one embodiment the controller comprises means for including an auxiliary time slot for random use by nodes such as de-activated nodes.

Ideally each node comprises means for storing a configuration for later retrieval, the configuration being identified by a unique reference.

In a preferred arrangement the apparatus comprises infra-red communication means having transmitters and

receivers programmed to communicate at a high sequence change rate.

Ideally the rate has a frequency of greater than two seconds.

In a preferred embodiment the transmitter comprises means for encoding part of a transmitted signal, and changing the encoding method for a subsequent transmission.

Preferably the code is encoded by use of an encoding byte retrieved from an indexed table, a successive byte in the table being used for each successive transmission.

Ideally the checksum of a transmit signal is encoded.

Ideally the apparatus comprises means for sensing the position of a player unit in the arena. This information may be used in a wide variety of ways to add to user enjoyment of the game. Beneficially, it allows information on the mobile player units position to be gathered using any suitable sensing technique. For example by the use of sensors underground, overhead or in a wall or obstacle.

Preferably the apparatus comprises at least one zone control unit comprising means for defining a game playing zone within the arena. Thus, game operators may assign special game attributes to various zones throughout the arena. These attributes may apply to all or selected zones and given zones may be defined in different ways for different players. Therefore in addition to using the location information for player tracking throughout the arena and numerous other game scenarios, the information may also be used to for player handicapping.

Preferably the zone control unit comprises a zone communication means for transmitting data to define a zone, and each mobile player unit comprises means for

receiving said data. This provides for zone definition and communication within a single operation and avoids the need for additional equipment such as sensors.

In one embodiment, the zone control unit comprises a zone controller. Preferably, the zone communication means comprises means for transmitting a unique zone identifier in said data under control of the zone controller. In one embodiment, the zone communication means comprises a radiation transmitter activated by the zone controller. These features provide for definition of a zone in a very simple manner. The zone space may be easily varied by varying the radiation field.

Ideally the radiation transmitter is an infra-red transmitter. Thus, the zone is defined in a relatively simple manner and may be readily altered by changing the spread of the infra-red field.

In one arrangement the zone communication means comprises means for transmitting status data to each mobile player unit. Thus, the zone control unit may also be used to transmit game information.

Preferably the zone communication means has a status receiver for receiving status data from a mobile player unit. Thus, the zone control unit may be used to receive game information.

Preferably the zone communication means comprises a transceiver.

Preferably the zone controller comprises a number of dip-switches for setting the zone identifier. This obviates the need for a specially programmed unit by allowing the code to be configured when the unit has been installed.

Ideally the zone controller comprises a microcontroller with associated memory and timing means. Thus, the zone information may be transmitted in a pulse mode reducing power requirements by using the microcontroller timer.

In one arrangement the zone communication means has a data communication means for communication with the central processor. This allows information to be passed to and from the controller through the zone unit. Advantageously this allows for the provision of zones whose characteristics may be changed as the game progresses. These might include no entry zones or safe zones for example.

Ideally the player unit receiving means has a zone receiver for receiving location data from the zone control unit. Thus, the game information received by the player unit is efficiently communicated to the mobile player unit processor. This information may be stored to provide a local movement history for each player and / or communicated to the central processor in the next player transmission time slot.

Preferably the zone receiver has decoding means for decoding location data and for detecting a safe zone. In this way zones may be defined that are safe for players to rest in as they can neither shoot or be shot. This further enhances player enjoyment of the game by strategic use of these areas.

Ideally the decoding means incorporates disabling means for preventing changes in game information. Thus, the game status information of each player unit may not be changed while in the safe zone except by the controller. This allows the controller to determine if a given player is overusing the safe zone and issue warnings or penalties accordingly.

Preferably the player unit receiving means is a two part radiation receiver a control receiver for receiving radio frequency signals and a zone receiver for receiving infra-red signals. Thus, by combining common features of the two receivers the size and weight of the receiver unit is reduced.

Ideally the mobile player unit includes an electronic gun.

Ideally the mobile player unit includes a body unit. Thus, the mobile player unit may be worn by the player during the course of the game.

In a preferred arrangement the body unit has a body armour shell with integral indication means to indicate that a player has been shot. Thus, information received locally or from the game controller may be indicated to the player using lights, buzzers or solenoids.

According to one aspect of the invention there is provided an electronic shooting game apparatus comprising:

a controller for controlling the course of a game in a game arena; and

at least one mobile player unit for use by a player during the course of the game, each mobile player unit having a mobile player unit communication means for communication with the controller in real time wherein each mobile player unit incorporates a timing means for determining a unique transmit period associated with the mobile player unit for transmitting game information to the game controller.

Ideally each player unit incorporates means for communication with another player unit in real time. In this way inter-player communication of information other than shooting information is possible.

Preferably the apparatus comprises at least two mobile player units each having independently operable mobile communication means for communication with the controller at pre-set intervals. Thus, each mobile player unit may transmit in turn obviating the need to be polled for game information by the controller thereby improving game response.

Preferably the mobile player unit incorporates and identification means for identifying the mobile player

unit to the controller. Thus, the controller recognises source of the game information received and may compile it with information from other player units to provide team status information. Further is allows for a number of games between a number of teams to take place in the same game playing arena simultaneously without interacting.

Preferably the mobile player unit incorporates a position indicating means for receiving location information from mobile player units in the game playing arena and for displaying the relative positions of other mobile player units. Thus, a tracking device or player radar is provided to track fellow team members and or opposing team members during the course of the game.

Ideally the position indicating means has a filter means for removing the location information of selected mobile player units. Thus information about players of a different game happening in the same arena at the same time is not shown preventing unwanted interaction.

Preferably the position indicating means is provided by a liquid crystal display communicating with the mobile player unit communication means. Thus, the information received is displayed in a simple and efficient manner.

Advantageously the electronic shooting game apparatus allows each mobile player unit to interact with the other mobile player units in real time. Real time in this context is taken to be less than one second being the maximum acceptable time in which responses to game events may issue without reducing game enjoyment.

Detailed Description

The invention will be more clearly understood from the following description of some embodiments thereof, given by way of example only, with reference to the accompanying drawings, in which:

Fig. 1 is a block diagram of an electronic shooting game apparatus according to the invention;

Fig. 2 is a plan view from above of a game playing arena divided into zones;

Fig. 3 is a side view of a zone identification unit in operation;

Fig. 4 is a block diagram of a single zone identification unit;

Fig. 5 is a elevational view of a player unit;

Fig. 6 is a diagrammatic view of a body unit shown in Fig 5;

Fig. 7 is a block diagram of an arena control device forming part of the invention;

Fig. 8 is a timing diagram of an electronic shooting game apparatus according to the invention;

Fig. 9 is a block diagram of an alternative electronic shooting game apparatus according to the invention; and

Fig. 10 is a plan view of an alternative game playing arena shown in Fig. 9, divided into zones.

Referring to the drawings and initially to Figs. 1 to 7 there is shown an electronic shooting game apparatus 1. The apparatus 1 has a controller for controlling the course of a game in a game arena, the controller comprising a central processor 2, and a number of control devices 3 distributed throughout the arena. The apparatus also has a game communication means for controlling wireless communication between a number of mobile player units 4, and the controller in real time.

Each mobile player unit 4 is carried by a player and has a unique communication time slot, wherein game information is communicated around the arena, controlled by a communication means on the mobile player unit 4. The communication means is provided by a player unit communicator 16 and allows communication between the mobile player unit 4 and the central processor 2 as well as to other mobile player units 4. A unique communication time slot for each mobile player unit 4 ensures that responses to game events issue very quickly without the need for complex and expensive equipment.

The player unit communicator 16 has a memory chip 17 connected to a microprocessor 18 and associated timer 18(a) for controlling communication to and from the player unit communicator 16. The microprocessor 18 in turn is connected to an infra-red receiver 19 and a radio frequency transceiver formed by a radio frequency receiver 20, a radio frequency transmitter 21 and an aerial 22.

The control device 3 has a device communication microcontroller 23 with internal memory 24 and timer 25. The device communication microcontroller 23 is connected to the central processor 2 through a data buffer 26 and a network cable 27. The device communication microcontroller 23 is also connected to a device transceiver 28 in turn connected to a device aerial 29.

The apparatus 1 also has means for sensing the position of the player unit 4 in the arena 7 provided by a number of zone control units 5, each for defining a zone 6 within a game playing arena 7. Each zone control unit 5 has a data transmitter for transmitting location data to the mobile player unit 4 provided by an infra red transmitter 8 mounted on the zone control unit 5. The zone control unit 5 also has a zone identification means provided by a bank of dip-switches 9 and a zone microcontroller 10 with an integral timer 11 for controlling the infra red transmitter 8.

The mobile player unit 4 has an electronic gun 12 and a body unit 13. The body unit 13 has a body armour shell 14 with an indicator 15 to indicate a players game condition using a numbers of buzzers 15a and lights 15b.

Referring now to Fig. 8 there is illustrated a timing diagram showing the communication timing structure between the central processor 2, four control devices 3 and six mobile player units 4 indicated generally by the reference numeral 30. The diagram shows a synchronisation pulse 31, four control device transmit periods 3(a), 3(b), 3(c), 3(d), a system settle pulse 32 and six mobile player unit transmit periods 4(a), 4(b), 4(c), 4(d), 4(e) and 4(f).

In use, the central processor 2 sends a synchronisation pulse 31 on the network cable 27 to each control device 3. Upon receipt of the synchronisation pulse 31 through the data buffer 26, the device communication microcontroller 23 retrieves a value stored in internal memory 24 and sets the device timer 25 with this value and initiates the count. When the device timer 25 has completed this count the identity of the control device 3 also stored in the internal memory 24 is transmitted to the mobile player units 4 through the transceiver 28 and the device aerial 29.

The value stored in the internal memory 24 for each control unit 3 is different, being preset in the unit to correspond to one of the transmit periods 3(a) to 3(d). This allows each control unit 3 to transmit in turn without transmission interference.

As the mobile player unit 4 moves around the game playing arena 7 the signal containing the identity of the control device 3 is received through the radio frequency receiver 20 and aerial 22 and is passed to the microprocessor 18.

When the microprocessor 18 receives the signal it stores it in the timer 18(a). The microprocessor 18 then uses the information received to determine when the system

settle pulse 32 occurs by counting down from the value received. When the system settle pulse 32 begins the microprocessor 18 resets the timer 18(a) to a pre-set value stored in the memory chip 17, to determine the correct transmit period associated with that mobile player unit 4. Each mobile player unit 4 has a unique transmit period corresponding to one of the transmit periods 4(a) to 4(f). In this way each mobile player unit 4 may transmit the selected status information to the central processor 2 through the control devices 3 and the other mobile player units 4 in turn without transmission interference. The status information is received by the mobile player units 4 in the same way as timing information is received from the control devices 3.

The status information transmitted in this way is received and prioritised by the microprocessor 18 before being stored in the memory chip 17 prior to transmission. The status information includes details of shots fired and hits received from other mobile player units. The player scores a hit by firing the electronic gun 12 at the body unit 13 of an opponent. These hits are indicated to the player by activation of the buzzers 15(a) and lights 15(b).

In addition to the status information, location information is similarly transmitted. The location information is received from the zone control units 5.

The zone control unit 5 has a binary code encoded in the dip-switches 9. This code is transmitted through the infra-red transmitter 8 of each control unit to define each zone 6. The frequency of transmission of this binary code is determined by the value stored in the integral timer 11 of the zone microcontroller 10. The range and spread of the infra-red field defines the boundaries of the zone 6. This location information is received by the infra red receiver 19 on the mobile player unit 4 as the player enters each zone. This location information is again passed to the

microprocessor 18 prior to transmission in the next one of the transmit periods 4(a) to 4(f).

As the game progresses the information being transmitted in real time around the game playing area 7 in this way may include hit status, remaining shots, location, timing signals and similar electronic shooting game related information.

In more detail, the real time communication between the various communication circuits is achieved using a technique referred to in this specification as time slot multiplexing (TSM). Brief mention has already been made of the fact that each zone controller and mobile unit has a unique time slot for communication, thereby allowing a single channel to be used by a large number of nodes without any interference. It has also been mentioned that the micro-processor 18 of the player unit communicator 16 retrieves a value from its memory 17 and that the microcontroller 23 at each control device 3 also retrieves a value from its memory 24. This value may be referred to as an alias identifier or alias ID as it identifies the unique time slot which any particular node has at any time. A very important aspect of the invention is the fact that each node (player unit communicator 16 or control device 3) has a fixed or real identifier, hereinafter referred to as a real ID. A master node (the controller 2) dynamically relates an alias ID with the real ID of each node being utilised at any particular time. It transmits reconfiguration signals at the start of a session, which signals achieve the following:-

(a) They set the number of nodes to be operational and therefore set the length of the cycle to cater for that number of nodes without any redundant or unused time slots.

(b) They set an alias ID for each operational node. Therefore, each operational node knows its alias ID, which as described

above is the particular time slot for that session.

After the reconfiguration signal, the master node sends synchronisation signals at very frequent intervals, in one embodiment every second. These synchronisation signals are used for synchronisation of the clocks in the nodes so that the transmission of data from the nodes is accurately located in the correct time slot.

To describe this in more detail, each node can determine its unique time slot according to the following formula:-

TSM slot time = (Slot_Period X Alias ID)
...where

TSM slot time is a delay in time that occurs after the receipt of a TSM Request "synchronisation signal" (i.e. base time 0)

Slot_Period is a predefined time duration (can be dynamically redefined as needed).

Alias ID being a non-zero positive integer.

An initial configuration table stored in the master node (controller 2) may be as follows:-

Node Real ID	ALIAS ID
A	1
B	2
C	3
E	4
F	5
G	6
H	7
I	8
J	9
K	10

To broadcast this information to the nodes, the controller transmits a reconfiguration signal which includes the real ID in each successive time slot according to the order given in the above table. This order can be dynamically redefined at any time by the master node by transmitting a reconfiguration message prior to issuing information requested. For example, the order can be reversed by transmission of the following reconfiguration signal:-

Alias	1	2	3	4	5	6	7	8	910
Config	J	I	H	G	F	E	D	C	BA

Upon receipt of such a signal, each node identifies its own real ID and its location in the reconfiguration signal and therefore sets its alias ID (in memory) according to the following table:-

Node Real ID	ALIAS_ID
A	10
B	9
C	8
D	7
E	6
F	5
G	4
H	3
I	2
J	1

Alternatively, the master node can activate a subset of nodes that are eligible for a particular session by transmitting a reconfiguration similar such as:-

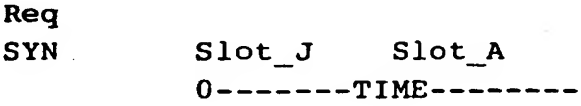
Alias	1	2	3
Config	J	A	B

Upon receipt of such a signal, the nodes will change their memory contents to reflect the alias ID's of the following table:-

Node Real ID	ALIAS_ID	Comment
A	2	
B	3	
C	-	not active
D	-	not active
E	-	not active
F	-	not active
G	-	not active
H	-	not active
I	-	not active
J	1	

A very important point to note is that after this reconfiguration signal, nodes C to I inclusive are redundant as alias ID's have been assigned only for nodes A, B and J. Thereafter, each multiplexing cycle will involve only three time slots, thereby providing for a much faster data capture.

From then on, the master node will transmit synchronisation signals every second to request information from the active nodes. Each active node reads the synchronisation signal and uses the synchronisation frame to reset its clock. It then uses its alias ID to count on each successive time slot until it recognises its own time slot and then transmits its information. This synchronisation would take the following:-



Please note that in the above signal each time slot following the synchronisation frame represents a time period for transmission of information from a node to the master node. For example, node J transmits information in the first time slot. The notation SLOT_J in the first time slot does not indicate that the real ID J appears in this time slot, it is simply a time frame during which node J can transmit information.

Another important aspect of the communication system is that an additional time slot may be included for auxiliary or random use. In one embodiment, this may be referred to as slot 0 in the following synchronisation signal:-

```
Req
SYN          Slot0    Slot_J    Slot_A    Slot_B
             0-------TIME---------------------->
```

Slot 0 (which is not a valid alias ID) is shared with all nodes. The purpose of this slot is to allow during a single TSM sequence a de-activated node that has not been inadvertently or abnormally reset ID to dynamically request re-activation. For example, the response may be represented as follows:-

```
Node
      Req
      SYN          F    Slot_J    Slot_A    Slot_B
                   0-------TIME---------------->
```

It will be clear that node F responds during time slot 0 to request re-activation. Upon receipt of such a return signal, the master node immediately re-configures its table and transmits a reconfiguration signal as follows in order to give the following configuration:-

Config	J	A	BF
Node Real ID	ALIAS_ID	Comment	
A	2		
B	3		
C	-	not active	
D	-	not active	
E	-	not active	
F	4	**Active**	
G	-	not active	
H	-	not active	
I	-	not active	
J	1		

Following this, subsequent synchronisation signals requesting information transmitted from the master node would be as follows:-

```
        Node
Req
SYN          Slot_J    Slot_A    Slot_B    Slot_F
        0-------TIME------------------------------>
```

Another important aspect of the invention is the fact that each reconfiguration signal will include a unique header which may be used as a reference. The configuration settings instructed by the reconfiguration signal may be stored in non-volatile memory at each node and used subsequently if a request is transmitted from the master node to use the configuration associated with that reference.

Regarding the hardware requirements to achieve the above operation, the communication circuits of the communicator 16 and the control devices 3 use an on-board microcontroller oscillator for timing. The timing reference for this oscillator uses an AT cut crystal oscillator which has the following characteristics:-

Basic Frequency: +/-20 ppm (parts per million) @ 25 degree C

Frequency Drift: +/-50 ppm per degree change in temperate (C)

Temperature Range: -10 to +60 degree C.

Base Frequency Tolerance Vs. Time: 40 uS / second Max

Frequency Drift: 3ms / second Max

From the characteristic above, any two crystals at 25°C will be within 40 ppm of one another (worst case). Therefore, two stand-alone oscillators using 1 MHZ crystal could differ up to 40 uS (microseconds) in one second of time.

It is assumed that the normal operating environment will be within the temperature range of between +10 and +40°C. Therefore, there is a maximum temperature swing of 30 degrees.

It is also assumed that all crystal will drift in the same direction (up in frequency or down in frequency) with respect to a change in temperature. Therefore, for a temperature range of 30°C, any two crystal could deviate a maximum of:

30 x 100 = 3000 ppm ..... where 30 is degrees change in C and 100 is the maximum ppm change per degree C.

Then, any two stand-alone oscillators using 1 MHZ crystal could differ up to 3000 uS (microseconds) in one second of time. Hence, in the course of once second (assuming the crystal characteristics stated above any two crystal would be within:

Base_Tolerance + Maximum_Frequency_Drift
= 3040 uS / Sec or 0.304%.

(+/-0.152% off centre frequency of the crystal).

The slot time for each node has a period of 15 ms. Up to 30 slot time periods follow each synchronisation signal. The maximum time to transmit an information request signal is:-

TSM_CYCLE time =
TSM_REQ time + 30 X slot_time_period.

In the above formula, TSM_CYCLE time is the total time for transmission of a single information request signal. TSM_REQ time represents a 15 ms synchronisation frame.

Only 46.5% of time within the period of 1 second is required for a TSM cycle. Since crystals could deviate as much as 0.304 milliseconds in one second, it can be

seen that the maximum deviation, following TSM synchronisation could be:-

46.5% of 3.04 ms or about 1.414 ms

This is to say that any two nodes, at the end of a TSM_Cycle would not have deviated more than +1.4 ms (see below).

Serialised radio data messages being transmitted within slot time periods. This timing is initiated/ synchronised by a TSM_REQ 'synchronising' radio frame. Taking into account distortion of the synchronising sync signal (envelope and/or amplitude) and microcontroller software timing resolution, an added delay of about +50 microseconds is possible.

Therefore the maximum deviation during a TSM_CYCLE is about 1.465 ms or about plus/minus 0.75 ms.

All serialised data that is sent within a slot time period is itself bit synchronised. By providing a preamble (header) at the beginning of a data frame (at least 3 characters at 4800 baud = 5ms) and assuring that the data frame time, in total, is:

Data_Frame time is less than or equal to *slot_time_period minus 1.465 ms.*

At the end of a TSM-Cycle (last slot time period), a node's interpretation of the slot's start could be early or late by as much as 0.75 ms.

If early, 0.75 milliseconds of preamble data would be sent during the previous slots trailing edge (as discussed above). This trailing slot time period is not used and no corruption or interference between adjacent slots time period data frames will occur.

If late, the frame would fall within 0.75 ms of the unused time at the trailing edge of a slot.

If a data frame is 0.75 ms late and the next slot is 0.75 ms early, still there is time at the end and beginning (i.e. preamble) to tolerate this maximum deviation.

Regarding the communication of infra-red (IR) signals, the techniques used greatly assist in overcoming the problem posed by possible use of universal learning IR devices (ULIRD). Such devices learn codes by detecting and storing codes, typically during a 2-3 second period.

In the apparatus 1, the IR transmitters are programmed to change the IR data transfer at least once every 2 seconds. A synchronising pulse based on an external common timer or an onboard oscillator achieves this. By changing the IR sequence at this rate, a ULIRD would not be capable of capturing the code. Further, the transmitters are programmed to modify the checksum before transmission by use of an encoding byte. The checksum is in one embodiment modified by applying an encoding byte using an XOR operation. The checksum is decoded at the IR receiver.

In more detail, the method of encoding used is as follows:

Data Frame

SOF,DAT1,DAT2,.....DATn,CHKSUM

where SOF - Start of frame byte
DATn - nth data byte
CHKSUM - sum of SOF and all data bytes.

Transmitted Frame

SOF,DAT1,DAT2,.....DATn,(CHKSUM xor CODE)

A table of codes stored at both transmitting and receiving devices is indexed each time the code is to be changed. Until the next code changeover time, this code is XORed with the checksum of data frames for transmission, and the same code is XORed with the checksum byte on reception.

Table of CODEs
Time1 CODE1
Time2 CODE2
"
"
TimeN CODEN

The ULIRD will be able to learn one IR data transfer. However, when the ULIRD transmits the learned data, the encoding byte will have changed and the learned data transfer will be invalid.

On each changeover time the table index is incremented. When the end of the table is reached, the index is reset to the start of the table and the process is repeated. Therefore if one data transfer is learned by the ULIRD, this data will in time become valid again. The larger the table of codes is the more effective the protection against the ULIRD.

It will thus be appreciated that the electronic shooting game apparatus provides for considerably improved player interest as it represents a new dimension in the interactivity of electronic shooting games. Role playing scenarios may be introduced by the inclusion of video walls or similarly interactive devices and by transmission of game instructions through the game controller in response to player status or certain game conditions. Handicapping systems may be introduced to make the game as competitive as possible. Team playing scenarios may be developed by ignoring the transmission of certain pieces of information to certain players or within parts of the arena. Players movement within the arena may also be controlled by punishing lack of movement when the same location is reported a number of times.

It will be appreciated that the real time communication features of the invention allow for very flexible communication with varying numbers of active nodes in a

real time manner. This allows, for example, the team set-ups in a laser shooting game to be changed very frequently in a very simple manner. This is achieved by a simple transmission of a single configuration signal which resets all nodes, both hard-wired and wireless. This method of communication overcomes the problems of conventional time division multiplexing schemes whereby the numbers of time slots and nodes are fixed and there is very little flexibility. It also provides a considerable amount of flexibility by virtue of the fact that nodes can become re-activated during a game or at unusual times generally. This is achieved by use of the time slot 0. Additionally the controller can use this slot to broadcast game information to all of the player units using this time slot or to a single player unit or group of player units. The game information to be transmitted may be either re-configuration information, passive game information to be stored in the player unit or active game information requiring immediate processing and subsequent action by the player unit.

The invention is not limited to the embodiment illustrated in Figs. 1 to 8. Referring now to Figs. 9 and 10 there is illustrated an alternative construction of an electronic shooting game apparatus, indicated generally by the reference numeral 40. Parts similar to those described with reference to Figs. 1 to 8 are identified by the same reference numerals.

In this arrangement each alternate zone 6 is defined by the absence of a zone control unit 5 thus the players movements may be monitored by storing the last location information of a mobile player unit until a new zone 6 is entered. Advantageously this reduces the number of zone control units required.

It is envisaged that real time communication could be achieved by a different suitable communication method such as by polling. The important point is that interference is avoided.

It is envisaged that the control unit microcontroller could be replaced by a microprocessor allowing more detailed processing to be carried out. It is further envisaged that the transceiver arrangement in the mobile player unit might be replaced by a transponder or similar unit to respond to such a control unit. In this way the transponder in the mobile player unit could be activated by the a control unit and the resulting game response be determined by the microprocessor.

The apparatus of the invention need not necessarily define zones in the arena. It could operate to sense players locations without relating location to zones. It is envisaged that the means for sensing player position in the arena may be provided using any suitable sensing technique, whether the arena is divided into zones or not. Pressure, light, movement or sound sensitive devices may equally be used to sense a players position and the transmission of the information relating to the player may be achieved using any suitable transmission technique or transmission media.

It envisaged that the zone control units could incorporate a receiver for remote communication with the central processor. It is also envisaged that the zone control units could be configured to define a "no entry" zone by transmitting a signal to adversely affect the players status and that the location of such zones could be changed during the course of a game. One or more zone control units could also be configured to transmit a safe zone code to the mobile player units within the zone. A zone of this type could be used within the context of the game to define a neutral zone where a player could not shoot or be shot. Such a zone could also be moved by the central processor during the course of a game. It is further envisaged that the zone identification means either alone or in combination with the central processor could maintain a location history for the player to prevent the player revisiting a zone or to track a players progress throughout the game playing area. In addition to tracking a players progress through the game playing area it is envisaged

that the information could be used to actuate a voice prompt unit, a visual or alternative indicator to relay a system message to the player. A unit of this type could be used to tell the player that he / she has entered a no entry zone and that a penalty was imminent or to warn a player not to run through the zones. A warning of this type would greatly improve the safety of the game.

It is envisaged that the mobile player units could be provided as powered vehicles such as battery or player powered carts. It is also envisaged that these mobile player units would have an appearance suitable to the electronic shooting game environment such as tanks or armoured vehicles. It is further envisaged that the units could be provided as airplanes travelling on rails above the game playing area.

It is envisaged that the timing means of the player units could be located within the control device structure allowing the device controllers to request player units to transmit information either in a polled manner or randomly.

It is also envisaged that the central processor could control both mobile and stationary targets or hazards and that mobile player units could communicate with such targets.

It is further envisaged that the unique identity of each mobile player unit may be easily modified. This allows for the minimum number of transmission periods to be obtained without the necessity of knowing which player unit transmits in which transmit period thus improving communication speeds.

It is envisaged that additional communications channels could be added, increasing band width. In this way a channel could be reserved for a particular team or additional players may be added without adversely affecting the real time communication of the system. It is further envisaged that certain communication channels

be reserved for certain types of information. It is also envisaged that the transmission media be of any suitable type. It will be appreciated that the control device may include an additional microprocessor or microcontroller to control communication with the mobile player units in an efficient manner.

It is envisaged that the controller could communicate interactively with similar controllers in remote locations to form an arena network providing for inter game playing area games. Similarly, it is envisaged that the controller in a remote location could be provided by a personal computer either with or without a mobile player unit attached, allowing a remote player unit to interact with the game in real time. This remote player unit need not necessarily be located in an arena. It is also envisaged that the controller could incorporate elements of popular games or situations to enhance the role playing aspect of the game.

It will be appreciated that the combination of any of the aforementioned features may be used to sustain player interest.

Many other variations on the specific embodiments of the invention described will be readily apparent and accordingly the invention is not limited to the embodiments hereinbefore described which may be varied in both construction and detail.

CLAIMS

1. An electronic shooting game apparatus comprising:

a controller for controlling the course of a game in an arena;

at least one mobile player unit; and

a game communication means comprising means for wireless communication between the controller and each mobile player unit in real time.

2. An electronic shooting game as claimed in claim 1, wherein the game communication means comprises a mobile player unit communication means for directing communication of each mobile player unit during a unique time slot associated with each mobile player unit.

3. An electronic shooting game apparatus as claimed in claim 2, wherein : -

the controller comprises a control processor and at least one control device, and

the game communication means comprises a player communication means in the control device, the control device being mounted in the arena for controlling communication between the central processor and each mobile player unit during the unique communication time slot.

4. An electronic shooting game apparatus as claimed in claim 3 wherein the controller comprises a central processor communicating with a plurality of physically separate control devices mounted in the arena.

5. An electronic shooting game apparatus as claimed in claims 3 or 4 wherein the player communication means has a transmitter with an associated transmission field in the arena, for transmitting game information from the control device to each mobile player unit located within the transmission field.

6. An electronic shooting game apparatus as claimed in claim 5 wherein each control device comprises a timing means for determining a unique control device transmit period for the player communication means associated with the control device.

7. An electronic shooting game apparatus as claimed in claim 5 or claim 6 wherein the transmitter is a radio frequency transmitter.

8. An electronic shooting game apparatus as claimed in claims 3 to 6 wherein each player communication means has a player communication controller and a device identification means for controlling the player communication means.

9. An electronic shooting game apparatus as claimed in claims 3 to 8 wherein the player communication means has a receiver for receiving signals from the mobile player unit.

10. An electronic shooting game apparatus as claimed in claim 9 wherein the transmitter and receiver are combined as a transceiver.

11. An electronic shooting game apparatus as claimed in claims 3 to 10 wherein the control device has a host communication means for communicating with the central processor.

12. An electronic shooting game apparatus as claimed in claim 11 wherein the host communication means has a host communication controller, a data

buffer and a communication link for connection between the central processor and the data buffer.

13. An electronic shooting game apparatus as claimed in claim 12 wherein the host communication controller and the player communication controller are integrally formed as a device communication controller.

14. An electronic shooting game apparatus as claimed in claim 13 wherein the device communication controller is a microcontroller with associated memory and timing means for controlling communication between the control device and the central processor and between the control device and the mobile player unit.

15. An electronic shooting game apparatus as claimed in any of claims 2 to 14 wherein each mobile player unit communication means has a processor with associated memory means for controlling the mobile player communication means.

16. An electronic shooting game apparatus as claimed in claim 15 wherein the mobile player unit communication means has a player unit transmitter for transmitting game information from the mobile player unit to the control device.

17. An electronic shooting game apparatus as claimed in claim 16 wherein each mobile player unit incorporates a timing means for determining a unique transmit period associated with the mobile player unit.

18. An electronic shooting game apparatus as claimed in claim 17 wherein the mobile player unit communication means has a player unit receiving means and a player unit transmitter.

19. An electronic shooting game apparatus as claimed in claim 19 wherein the player unit receiving means has a control receiver for receiving status data from the controller.

20. An electronic shooting game apparatus as claimed in claim 19 wherein the control receiver includes means for receiving status data from another mobile player unit.

21. An electronic shooting game apparatus as claimed in claim 20 wherein the control receiver and the player unit transmitter are formed as a mobile player unit transceiver.

22. An electronic shooting game apparatus as claimed in any of claims 3 to 21 wherein the game communication means comprises means in the controller for assigning a unique communication time slot period for each mobile player unit and control device node by storing relationships between fixed or real node identifiers and alias identifiers, the alias identifiers identifying the unique time slot period.

23. An apparatus as claimed in claim 22 wherein the controller comprises means for transmitting signals re-configuring the apparatus by re-assigning alias identifiers with real identifiers in real time.

24. An apparatus as claimed in claim 23 wherein the controller comprises means for re-configuring the apparatus by transmitting a reconfiguration signal comprising a reference followed by a series of real identifiers in successive time slots and each node comprises means for identifying its real identifier and storing an indication of the position of said identifier in the reconfiguration signal to set its alias identifier as a configuration.

25. An apparatus as claimed in claims 22 to 24 wherein the controller comprises means for assigning alias identifiers to only a portion of the nodes of the apparatus at any particular time.

26. An apparatus as claimed in any of claims 22 to 25 wherein the controller comprises means for transmitting synchronisation signals which include a synchronisation frame for synchronisation of clocks in the nodes, followed by a series of time slots within which nodes can respond in the relevant appropriate time slot, each node determining its time slot according to its current alias identifier.

27. An apparatus as claimed in any of claims 22 to 26 wherein the controller comprises means for including an auxiliary time slot for random use by nodes such as de-activated nodes.

28. An apparatus as claimed in any of claims 22 to 27 wherein each node comprises means for storing a configuration for later retrieval, the configuration being identified by a unique reference.

29. An apparatus as claimed in any preceding claim wherein the game communication means comprises infra-red communication means having transmitters and receivers programmed to communicate at a high sequence change rate.

30. An apparatus as claimed in claim 29 wherein the rate has a frequency of greater than two seconds.

31. An apparatus as claimed in claims 29 or 30 wherein a transmitter comprises means for encoding part of a transmitted signal and changing the encoding method for a subsequent transmission.

32. An apparatus as claimed in claim 31 wherein the code is encoded by use of an encoding byte retrieved from an indexed table, a successive byte in the table being used for each successive transmission.

33. An apparatus as claimed in claims 31 or 32 wherein a checksum of a transmit signal is encoded.

34. An electronic shooting game apparatus as claimed in any preceding claim comprising means for sensing the position of a player unit in the arena.

35. An electronic shooting game apparatus as claimed in claim 34 comprising at least one zone control unit comprising means for defining a game-playing zone within the arena.

36. An electronic shooting game apparatus as claimed in claim 35 wherein the zone control unit comprises a zone communication means for transmitting data to define a zone, and each mobile player unit comprises means for receiving said data.

37. An electronic shooting game apparatus as claimed in claim 35 or 36 wherein the zone control unit comprises a zone controller.

38. An electronic shooting game apparatus as claimed in claim 37 wherein the zone communication means comprises means for transmitting a unique zone identifier in said data under control of the zone controller.

39. An electronic shooting game apparatus as claimed in claims 37 or 38, wherein the zone communication means comprises a radiation transmitter activated by the zone controller.

40. An electronic shooting game apparatus as claimed in claim 39 wherein the radiation transmitter is an infra-red transmitter.

41. An electronic shooting game apparatus as claimed in any of claims 36 to 40 wherein the zone communication means comprises means for transmitting status data to each mobile player unit.

42. An electronic shooting game apparatus as claimed in any of claims 36 to 41 wherein the zone communication means has a status receiver for receiving status data from a mobile player unit.

43. An electronic shooting game apparatus as claimed in claim 42 wherein the zone communication means comprises a transceiver.

44. An electronic shooting game apparatus as claimed in any of claims 37 to 43 wherein the zone controller comprises a number of dip-switches for setting the zone identifier.

45. An electronic shooting game apparatus as claimed in any of claims 37 to 44 wherein the zone controller comprises a microcontroller with associated memory and timing means.

46. An electronic shooting game apparatus as claimed in any of claims 36 to 45 wherein the zone communication means has a data communication means for communication with the central processor.

47. An electronic shooting game apparatus as claimed in any of claims 36 to 46 wherein the player unit receiving means has a zone receiver for receiving location data from the zone control unit.

48. An electronic shooting game apparatus as claimed in claim 47 wherein the zone receiver has

decoding means for decoding location data and for detecting a safe zone.

49. An electronic shooting game apparatus as claimed in claim 48 wherein the decoding means incorporates disabling means for preventing changes in game information.

50. An electronic shooting game apparatus as claimed in claim 49 wherein the player unit receiving means is a two part radiation receiver, a control receiver for receiving radio frequency signals and a zone receiver for receiving infra-red signals.

51. An electronic shooting game apparatus as claimed in any preceding claim wherein the mobile player unit includes an electronic gun.

52. An electronic shooting game apparatus as claimed in any preceding claim wherein the mobile player unit includes a body unit.

53. An electronic shooting game apparatus as claimed in claim 52 wherein the body unit has a body armour shell with integral indication means to indicate that a player has been shot.

54. An electronic shooting game apparatus comprising:

a controller for controlling the course of a game in a game arena; and

at least one mobile player unit for use by a player during the course of the game, each mobile player unit having a mobile player unit communication means for communication with the controller in real time wherein each mobile player unit incorporates a timing means for determining a unique transmit period associated with

the mobile player unit, for transmitting game information to the game controller.

55. An electronic shooting game apparatus as claimed in claim 54 wherein each player unit incorporates means for communication with another player unit in real time.

56. An electronic shooting game apparatus as claimed in any preceding claim having at least two mobile player units each having independently operable mobile communication means for communication with the controller at pre-set intervals.

57. An electronic shooting game apparatus as claimed in claim 56 wherein a mobile player unit incorporates an identification means for identifying the mobile player unit to the controller.

58. An electronic shooting game apparatus as claimed in claim 57 wherein a mobile player unit incorporates a position indicating means for receiving location information from mobile player units in the game playing area and for displaying the relative positions of other mobile player units.

59. An electronic shooting game apparatus as claimed in claim 58 wherein the position indicating means has a filter means for removing the location information of selected mobile player units.

60. An electronic shooting game apparatus as claimed in claims 58 or 59 wherein the position indicating means is provided by a liquid crystal display communicating with the mobile player unit communication means.

61. An electronic shooting game apparatus substantially as hereinbefore described with reference to the accompanying drawings.

Fig.1

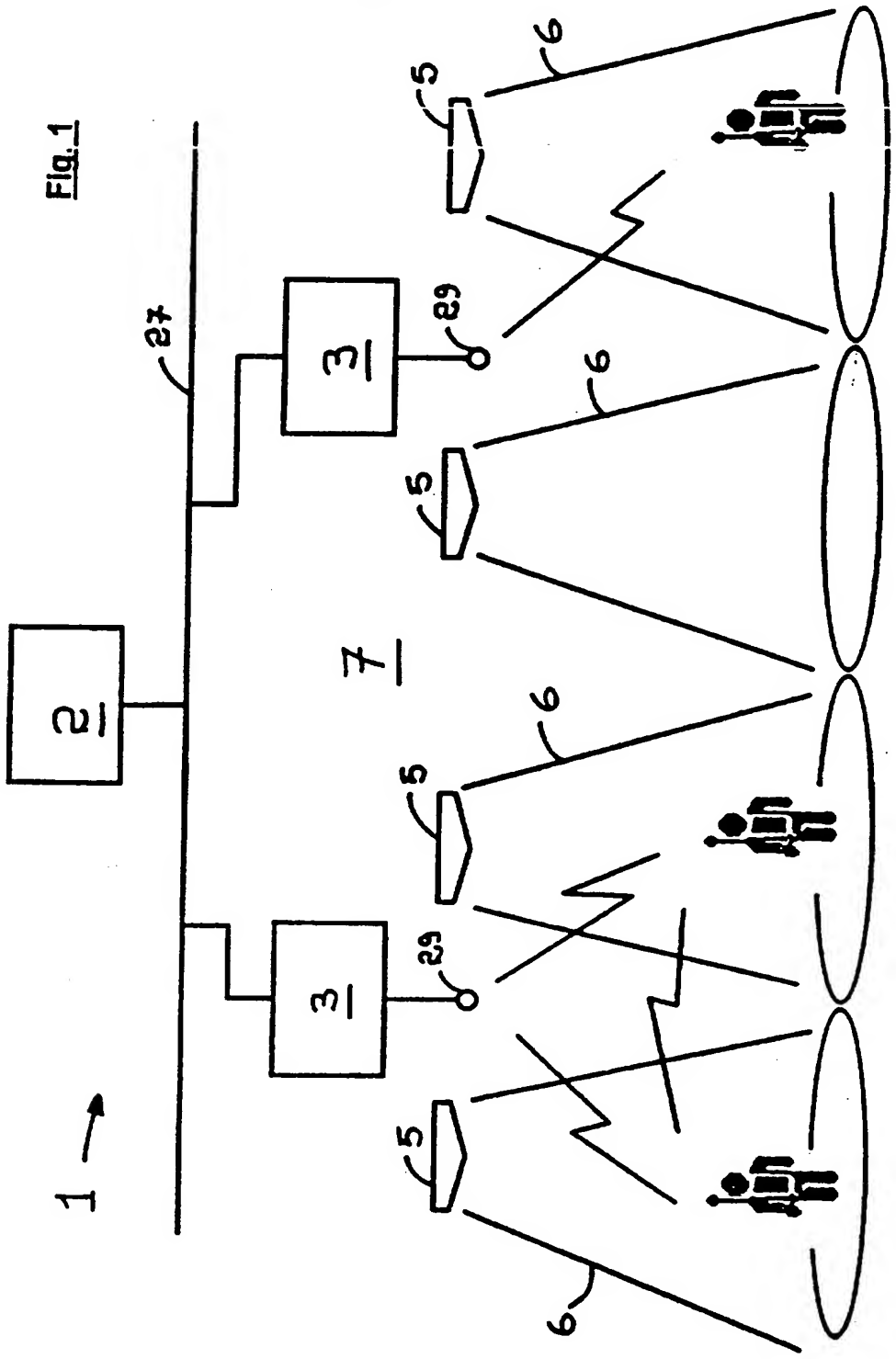


Fig.2

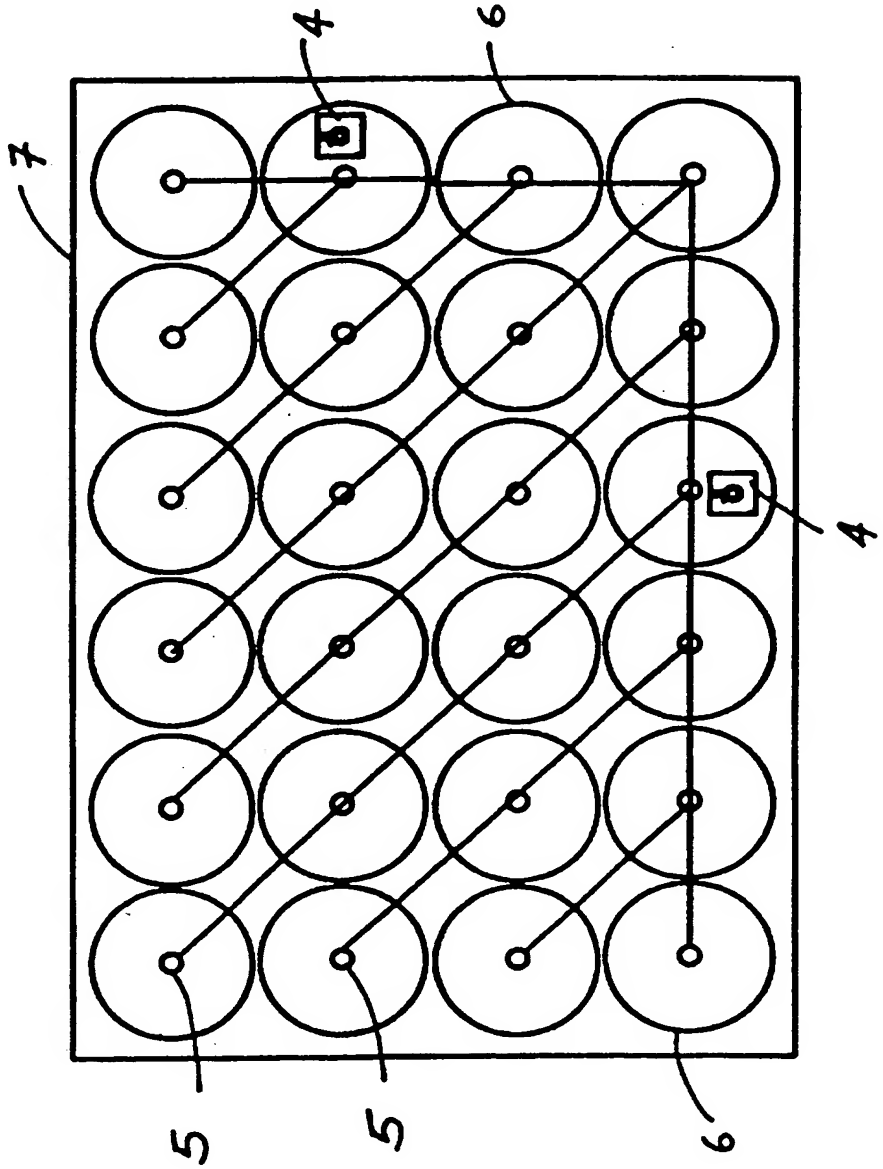
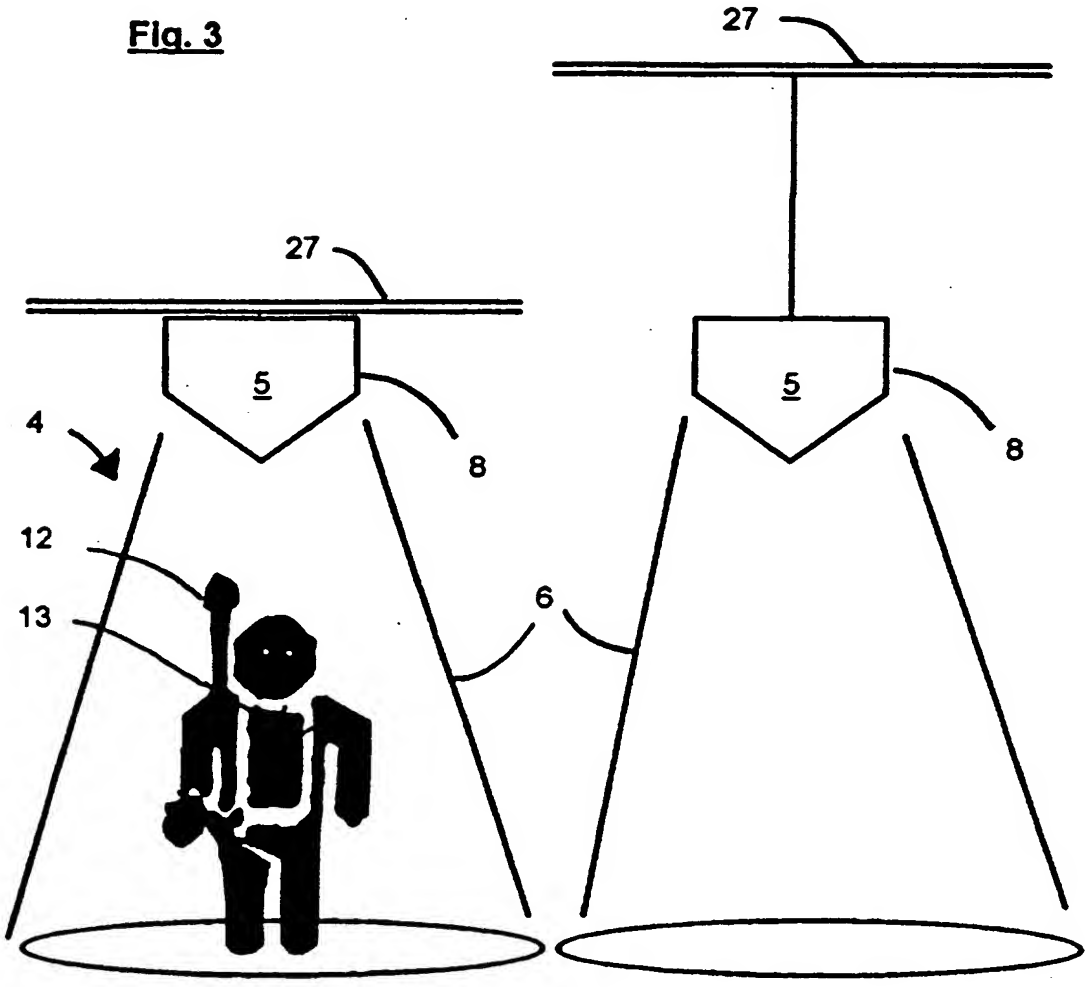


Fig. 3



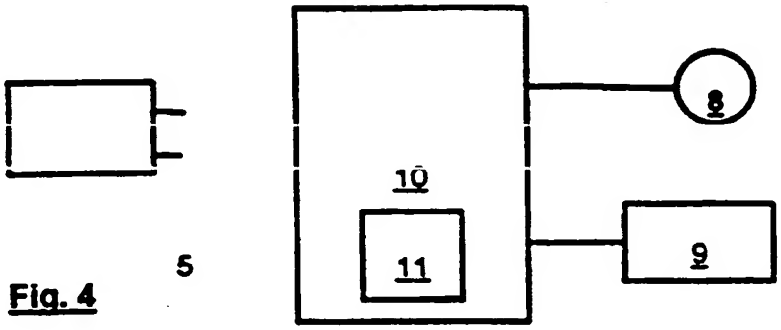


Fig. 4

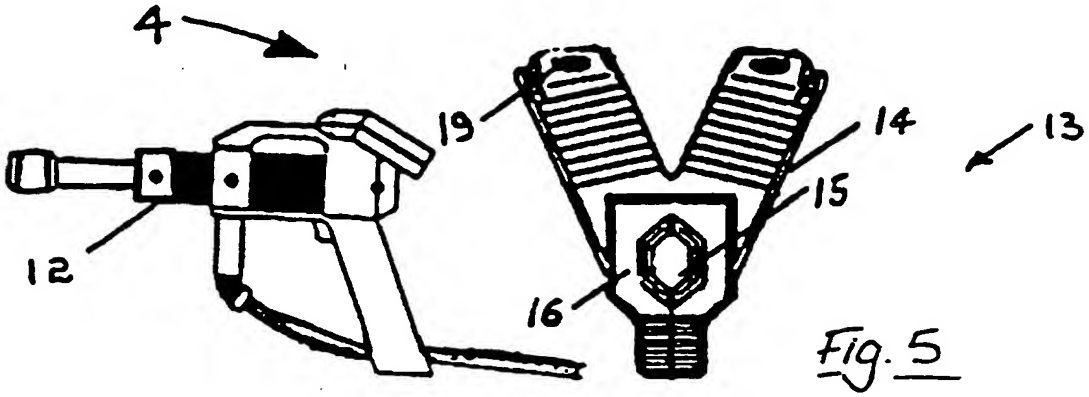


Fig. 5

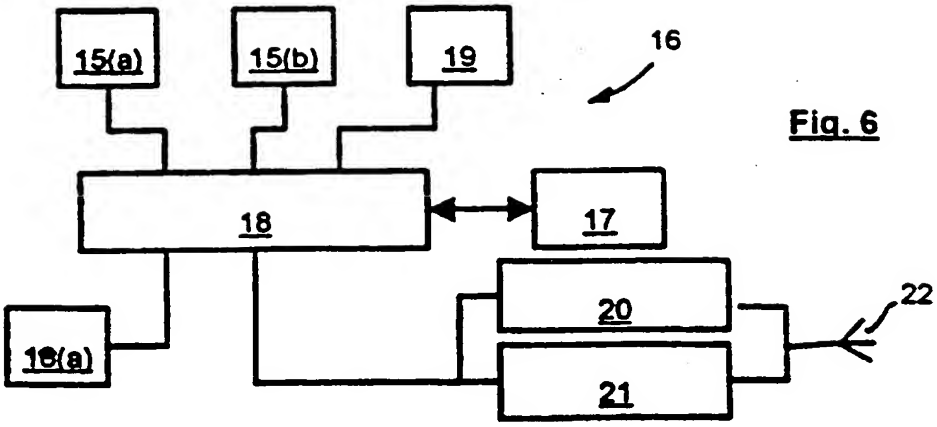


Fig. 6

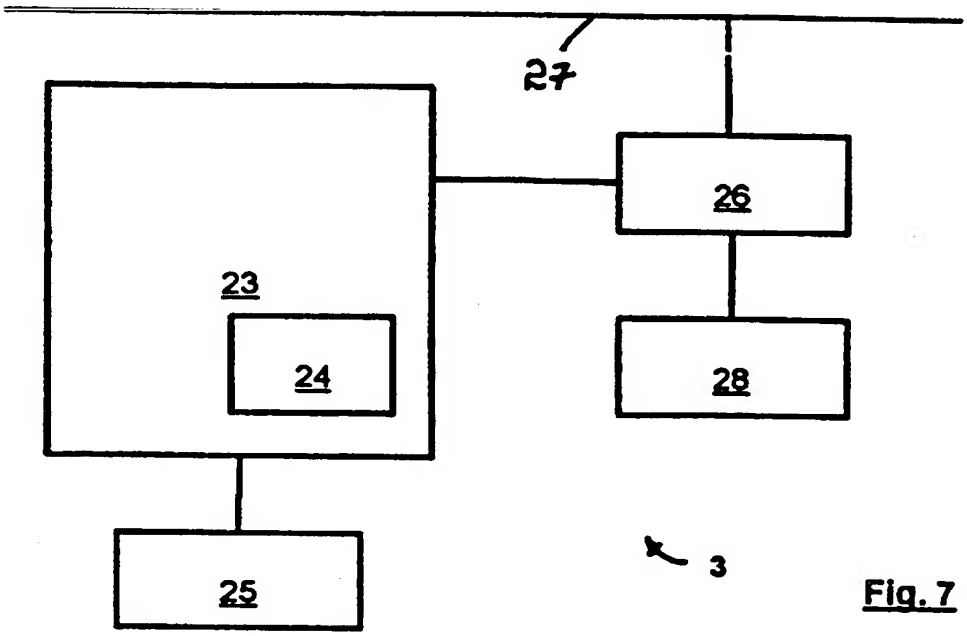


Fig. 7

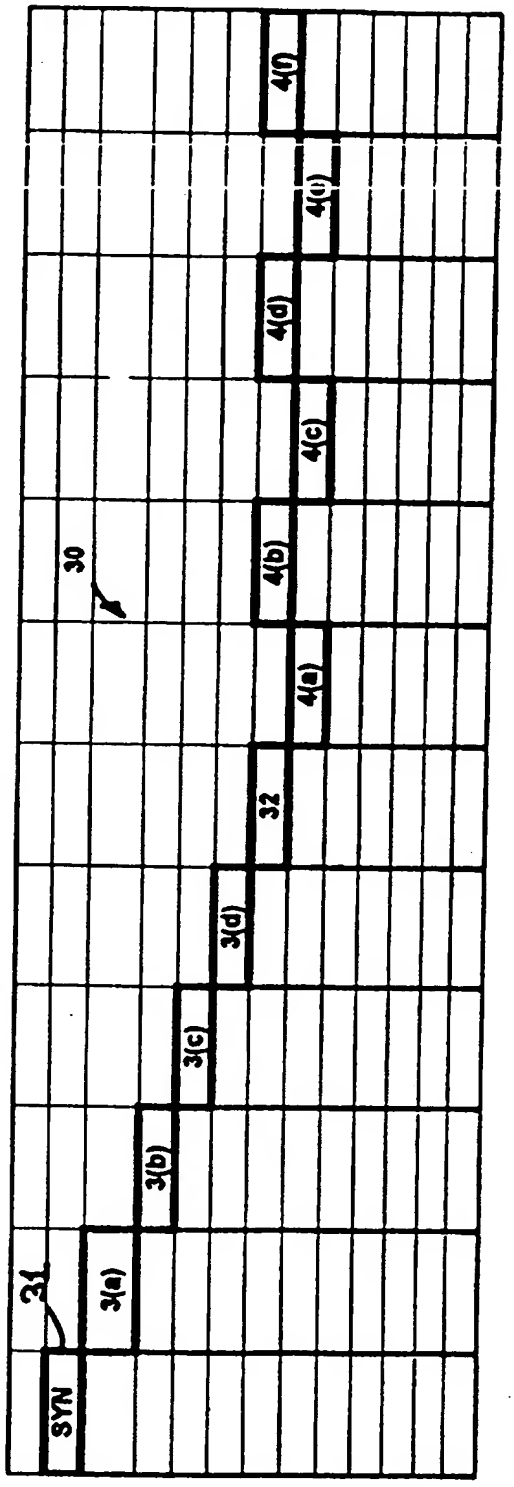


Fig. 8

Fig. 9

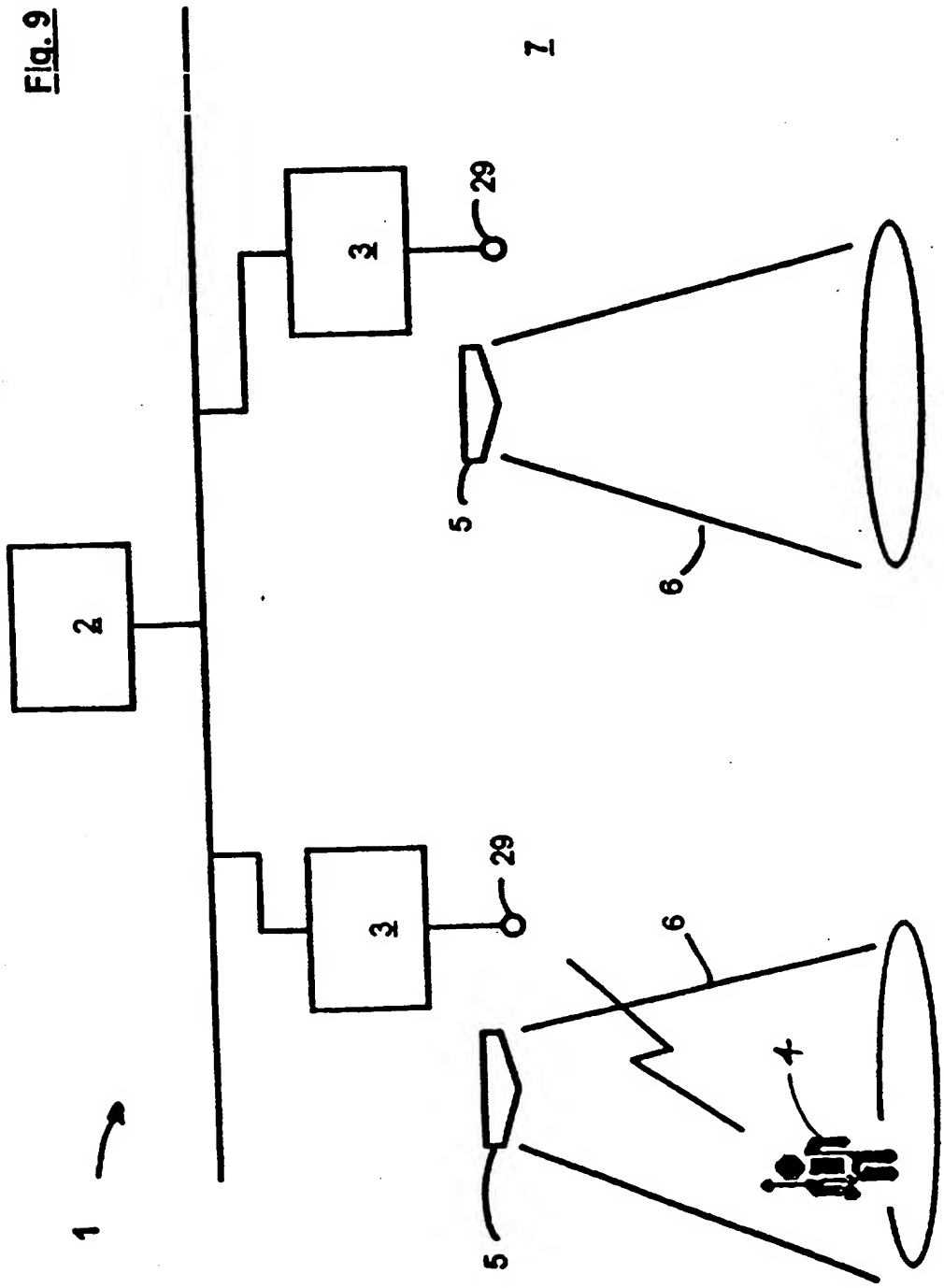
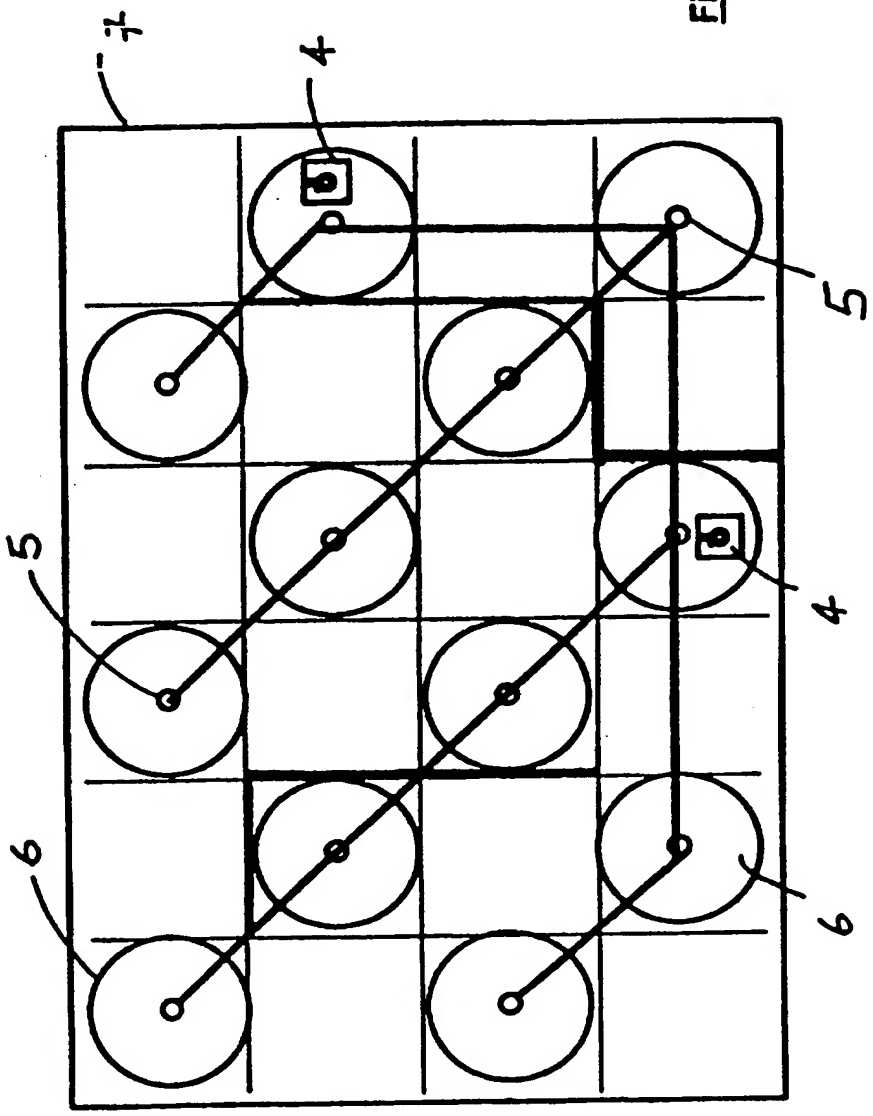


Fig.10



INTERNATIONAL SEARCH REPORT

Inter. nal Application No
PCT/IE 95/00058

A. CLASSIFICATION OF SUBJECT MATTER
IPC 6 F41J5/02

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)
IPC 6 F41J A63F

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practical, search terms used)

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category *	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	US,A,5 354 057 (PRUITT) 11 October 1994 see the whole document	1-5, 7-10,15, 16,34, 35, 51-54, 56,57,61
X	US,A,4 695 058 (CARTER) 22 September 1987 cited in the application see the whole document	1,2,29, 34, 51-54,61
A	US,A,5 320 358 (JONES) 14 June 1994	1,34,54
A	WO,A,91 17515 (DISYS INC) 14 November 1991	1

-/--

[X] Further documents are listed in the continuation of box C.

[X] Patent family members are listed in annex.

* Special categories of cited documents :

"A" document defining the general state of the art which is not considered to be of particular relevance

"E" earlier document but published on or after the international filing date

"L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)

"O" document referring to an oral disclosure, use, exhibition or other means

"P" document published prior to the international filing date but later than the priority date claimed

"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention

"X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone

"Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art.

"&" document member of the same patent family

Date of the actual completion of the international search	Date of mailing of the international search report
14 March 1996	25. 03. 96

Name and mailing address of the ISA	Authorized officer
European Patent Office, P.B. 5818 Patentlaan 2 NL - 2280 HV Rijswijk Tel. (+ 31-70) 340-2040, Tx. 31 651 epo nl, Fax (+ 31-70) 340-3016	Triantaphillou, P

Form PCT/ISA/210 (second sheet) (July 1992)

INTERNATIONAL SEARCH REPORT

Inter nal Application No
PCT/IE 95/00058

C.(Continuation) DOCUMENTS CONSIDERED TO BE RELEVANT

Category *	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	EP,A,0 480 413 (NIPPONDENSO CO LTD) 15 April 1992	1

1

Form PCT/ISA 210 (continuation of second sheet) (July 1992)